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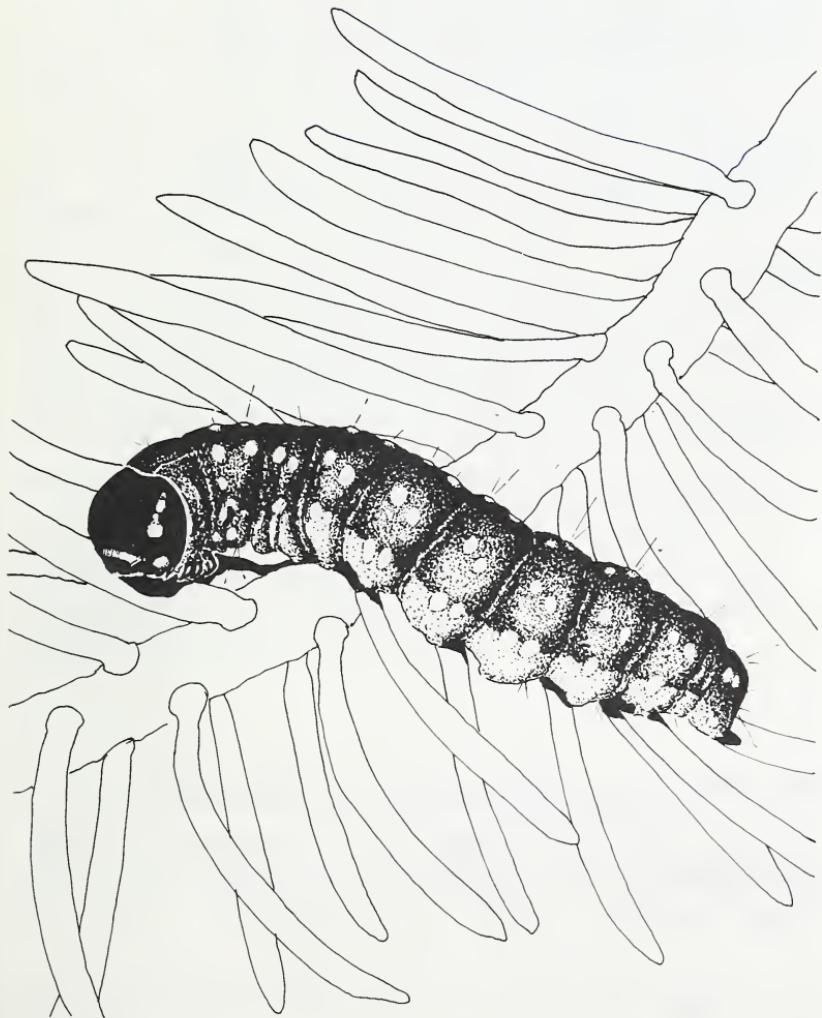
Canadian
Forestry
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Miscellaneous
Publication
Number 1448

Spruce Budworms Situation in North America 1984

ME 31-65

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<u>When you know</u>	<u>Multiply by</u>	<u>To find</u>
meters.....	3.281.....	feet
hectares.....	2.471.....	acres
cubic meters....	35.31	cubic feet

Spruce Budworms Situation in North America 1984

by Daniel R. Kucera¹ and
Robert G. Taylor²

In 1984, the spruce budworms exhibited a marked decline throughout North America. In the Eastern United States and Eastern Canada, defoliation, which occurred on 26.8 million hectares (ha) in 1983, covered only 23.4 million ha. In the Western United States and Western Canada, defoliation was also down--from 4.8 million ha to 4.5 million ha.

Nevertheless, defoliation did increase in the Prairie Provinces (Alberta, Saskatchewan, and Manitoba), northern California, Oregon, Washington, New Mexico, Minnesota, and Michigan.

Weather may have been an important factor in reducing defoliation in Eastern North America. The cool, wet spring (especially in June) continued into early summer. As a result, the larvae that were not killed by the unseasonable temperatures matured slowly.

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Furthermore, the heaviest cone crop in the last 10-40 years was recorded on spruce, fir, and pines. Bumper harvests occurred from the Lake States eastward to the Maritimes. These cone crops often made aerial surveys difficult. In some cases, it was hard to distinguish defoliation from upper canopies covered with cones.

Although defoliation in general is down, tree mortality continues in New England, in parts of the Lake States, in Quebec, and, to a lesser extent, in the other Eastern Provinces. Mortality occurs where stands are unprotected or conditions such that host trees are unable to recover from past defoliation.

The insect's principal host in the Eastern United States and Canada is balsam fir, followed by red spruce, white spruce, black spruce, and eastern hemlock. Significant areas of balsam fir have been killed; red spruce, white spruce, and eastern hemlock are all dying in increasing numbers. In New England, more than 25 percent of the red spruce is dead over several hundred thousand acres. In Eastern Canada, mortality is confined primarily to balsam fir.

In the Western United States and Canada, Douglas-fir is the principal host, along with grand fir, subalpine fir, white fir, and Engelmann spruce.

Suppression projects were carried out on 2.5 million ha in 1984, down from the 3.5 million ha treated in 1983.

The Canadian Provinces of Newfoundland, Nova Scotia, New Brunswick, Quebec, and Ontario carried out treatment. In addition, some spots were treated with the bacterium Bacillus thuringiensis (Bt) in Western Canada.

In the United States, cooperative Federal/State projects were conducted in New Mexico and Vermont. In Maine, 270,544 ha were treated by the State Bureau of Forestry. An additional 10,997 ha of Indian reservation lands were treated by the U.S. Department of Interior; private landowners treated 113,000 ha.

Overall, there has been a marked increase in the use of the biological insecticide Bt, in part because of its reduced cost and in part because of the improved efficacy of today's formulations.

The insecticide mexacarbate is once again being produced in the United States. After a lull of about 10 years, this material was used in Maine in 1984; the results were excellent.

The Canadian information was provided by the Provincial governments of Newfoundland, Nova Scotia, Prince Edward Island, New Brunswick, Quebec, Ontario, Manitoba, and British Columbia, as well as the Forest Insect and Disease Survey of the Canadian Forestry Service. The information was coordinated by the Forest Insect and Disease Survey, Canadian Forestry Service, and, in particular, by Edward George Kettela, Maritimes Forest Research Centre, Canadian Forestry Service.

The U.S. information was provided by Maine, New Hampshire, Vermont, Wisconsin, Minnesota, and Michigan; and by USDA Forest Service Regions 1 through 6 and 10 and the Northeastern Area State and Private Forestry field offices in St. Paul, MN, and Durham, NH. The information was coordinated by the USDA Forest Service.

All units of measure have been rounded off to the nearest thousand hectares, and data are the best available estimates at time of publication.

For further information, contact the USDA Forest Service, Northeastern Area, State and Private Forestry, 370 Reed Road, Broomall, PA 19008; or Forest Insect and Disease Survey, Canadian Forestry Service, 19th Floor, Place Vincent Massey, Ottawa, ON K1A 1G5.

Situation in 1984

Eastern and Prairie Provinces

Newfoundland--The total area of moderate to severe defoliation caused by the spruce budworm (Choristoneura fumiferana (Clemens)) decreased from 67,000 ha in 1983 to 15,300 ha in 1984. There was some additional light defoliation. The cold, wet weather in June probably caused populations to decline and larvae to develop late. Preliminary surveys indicate that the volume of timber lost did not increase greatly in 1984.

Nova Scotia--About 85,100 ha were defoliated in 1984 compared to 358,000 ha defoliated in 1983. Although moderate to severe defoliation occurred on only 58,700 ha, the infestation within this area intensified. There were an additional 26,400 ha of light defoliation.

No defoliation occurred on Cape Breton Island.

Prince Edward Island--The area of moderate to severe defoliation decreased to 15,000 ha in 1984. The area of dead and dying trees, however, remained stable at 30,000 ha.

New Brunswick--Moderate to severe defoliation occurred on 730,000 ha in 1984, a dramatic decrease from the 2.3 million ha defoliated in 1983. It is estimated that during this current outbreak the budworm has killed 6 million cubic meters of softwood.

Quebec--The area of moderate to severe defoliation decreased from 12.3 million ha in 1983 to 11.2 million ha in 1984. This decrease was probably caused by heavy tree mortality in

western Quebec that resulted in a lack of food for the budworm and by successful control operations in eastern Quebec.

Ontario--The area of moderate to severe defoliation decreased from 9.0 million ha in 1983 to 8.7 million ha in 1984. Defoliation declined in northeastern and southern Ontario, but more than doubled in northwestern Ontario.

Prairie Provinces--The spruce budworm caused moderate to severe defoliation on 170,000 ha in 1984, an increase over the 75,550 ha defoliated in 1983. The largest part of the defoliation--53,000 ha--occurred in Manitoba; the rest of the defoliation occurred in scattered, small pockets in Alberta and Saskatchewan.

Eastern United States

New England--In 1984, the spruce budworm defoliated over 2.2 million ha, a steady decline from the 2.5 million ha defoliated in 1983 and the 3.2 million ha in 1982.

Defoliation in Maine covered 2.2 million ha. The heaviest defoliation occurred in the southeastern, southwestern, and west-central portions of the State. Balsam fir mortality now exceeds 50 percent on over 300,000 acres. Spruce mortality, especially red spruce mortality, is also increasing; in some areas, more than 25 percent of the stems are dead.

In New Hampshire, only 377 ha in the extreme northern portion of the State were lightly defoliated. Defoliation has continued to decline since the outbreak in 1981, and almost

20,000 ha--worth over \$1.5 million--have been salvage cut within the last 5 years.

Vermont had no defoliation visible from the air: populations have dropped to their lowest level since the outbreak began in 1975. Compared to 1983, the numbers of large larvae and pupae were down 95 percent; moth catches were down 80 percent. Still, spruce and fir mortality were reported on over 18,000 ha.

Lake States--There was a marked increase in defoliation in Minnesota and Michigan and a slight increase in Wisconsin. Overall, 233,217 ha are infested, or about half the spruce-fir type in the three States. Losses are now estimated at over 4.2 million cubic meters. The area of tree mortality is extensive.

In 1984, Minnesota had its third consecutive increase in defoliation. The infested area now covers over 146,448 ha. Hardest hit is Cook County, which has severe defoliation on 60,467 ha. Approximately 47,000 ha of spruce and balsam fir have been partially defoliated on the Superior National Forest. Much of the defoliation is in the Boundary Waters Canoe area. In the Cloquet Valley of Minnesota, which also covers part of Cook County, the severity of the outbreak has increased for the second year: 106,000 ha had heavy defoliation in 1984; 29,100 ha in 1983. Both topkill and tree mortality occur extensively.

Both Michigan (77,920 ha defoliated) and Wisconsin (8,930 ha) had more acreage defoliated in 1984 than in 1983. In Wisconsin, severe defoliation occurred on about 4,860 ha in Ashland County. About 10-percent tree mortality and 25-percent topkill have resulted thus far.

Western Canada

In British Columbia, western spruce budworm (Choristoneura occidentalis (Freeman)) defoliated 62,000 ha of Douglas-fir, mainly in the Kamloops area. Most defoliation was classed as light or moderate; only 3,000 ha were severely defoliated. In permanent study areas where defoliation has occurred for up to 10 years, mortality averaged 6 percent.

The western spruce budworm and the 2-year budworm (Choristoneura biennis (Freeman)) caused defoliation in fir-spruce stands, primarily in the Prince Rupert and Prince George areas. The high incidence of the pathogen Beauveria bassiana contributed to the decline.

In addition, defoliation by the spruce budworm increased significantly for the first time since 1975. Moderate and severe feeding occurred on spruce and alpine foliage over more than 7,300 ha in the Liard River Valley of the Prince George area.

Western United States

Budworm activity remained at high levels in California, Oregon, Washington, Utah, Montana, Colorado, Arizona, and New Mexico.

Northern Region--Total western spruce budworm-caused defoliation in Montana, northern Idaho, and northwestern Wyoming declined from 1.0 million ha in 1983 to 900,000 ha in 1984.

In Montana, west of the Continental Divide, defoliation in all infested areas within the Bitterroot, Flathead, and Lolo National Forests declined during 1984. These forests had a net decrease of 160,000 ha. In addition, the Idaho portion of the Bitterroot National Forest reported defoliation on only 4,400 ha in 1984.

In Montana, east of the Divide, an increase of 164,000 ha occurred on the Custer, Lewis and Clark, Helena, and Deerlodge National Forests and in Yellowstone National Park. This increase was offset by a 117,000-ha decline on the Beaverhead and Gallatin National Forests.

In northern Idaho, the Nezperce National Forest recorded budworm defoliation for the first time since 1978 when 1,800 ha were infested. The 185 ha reported may represent the first evidence in several years of a new outbreak in northern Idaho.

Rocky Mountain Region--Visible defoliation in Colorado and Wyoming decreased from 1.1 million ha in 1983 to 888,000 ha in 1984.

The most extensive defoliation occurred in Colorado on the San Juan, Pike, and San Isabel National Forests. Defoliation was moderate, except in a few severely defoliated areas west of Denver.

In 1984, data were also collected from permanent budworm impact plots established in 1978 along the Colorado Front Range. These data are now being analyzed.

Southwestern Region--Western spruce budworm
activity continued at outbreak levels throughout
much of the mixed conifer type in New Mexico and
Arizona. Visible defoliation doubled. About
140,330 ha were defoliated in 1983, 280,000 ha
in 1984.

In New Mexico, most of the defoliation occurred
on the Carson, Santa Fe, Lincoln, and Cibola
National Forests and in the Taos Pueblo and
Mescalero Apache Indian Reservations. On the
Carson National Forest, some areas of concen-
trated mortality have occurred as a result of
several years of consecutive defoliation. The
extent of this mortality is currently being
evaluated.

In Arizona, most of the defoliation occurred on
the Kaibab National Forest and in Grand Canyon
National Park.

Intermountain Region--The western spruce budworm
defoliated 949,913 ha of Douglas-fir, grand fir,
and subalpine fir in Utah, western Wyoming, and
southern Idaho. In general, defoliation
decreased in extent and intensity in Idaho and
Wyoming but increased in Utah. Less defoliation
occurred in areas that had been defoliated for
several years; defoliation increased in areas
where infestations were relatively recent. The
pattern was for outbreaks to expand into
adjoining areas rather than for infestations to
develop in new, isolated areas.

In southern Idaho on the Boise, Caribou, Payette, and Targhee National Forests, defoliation was down in the older infestations. Marked reductions in defoliation also occurred on the Salmon and Challis National Forests, but this may have been due to adverse climatic conditions.

In Utah, infestations increased on the Dixie, Fishlake, and Manti-LaSal National Forests but decreased on the Wasatch-Cache National Forest.

In western Wyoming, the area and intensity of defoliation decreased on the Bridger-Teton National Forest.

Pacific Southwest Region--A budworm, Choristoneura carnana californica Powell, defoliated approximately 53,000 ha in Trinity and Shasta Counties in California. The defoliated stands were primarily Douglas-fir with a sprinkling of white fir; much of the defoliation occurred at altitudes of 610 to 1,525 meters.

Pacific Northwest Region--For the second year, the area of defoliation increased in Oregon and Washington. Defoliation by the western spruce budworm and the Modoc budworm (Choristoneura retiniana (Walsingham)) now covers 1.4 million ha.

In Oregon east of the Cascade Mountains, budworm defoliation increased on the Mount Hood and Deschutes National Forests and also on the Warm Springs Indian Reservation.

In central and northeast Oregon, budworm defoliation also increased from 949,092 ha in 1983 to 1.2 million ha in 1984. For 1985, heavy defoliation is expected on the Wallowa-Whitman and Umatilla National Forests, while light defoliation is expected on the Malheur and Ochoco National Forests.

In south-central Oregon, defoliation caused by the Modoc budworm increased on the Winema and Fremont National Forests and on Crater Lake National Park. The defoliated area expanded from 50,640 ha in 1983 to 195,818 ha in 1984. Light defoliation is expected in 1985.

The size of the western spruce budworm defoliation in Washington increased slightly on the Okanogan National Forest and adjacent State and private lands. In 1983, defoliation totaled 15,300 ha; in 1984, defoliation rose to 16,731 ha; and for the first time, defoliation--about 4,624 ha--was observed on the Tieton River drainage, Wenatchee National Forest. Light to heavy defoliation is expected in 1985.

Alaska Region--Although defoliation was detected on 1,000 ha in 1983, no defoliation was detected in Alaska in 1984--probably because the budworm population (Choristoneura biennis (Freeman) or C. orae (Freeman)), exhibits a high incidence of diapause in the second year. Studies to determine which species is most common are continuing.

Summary of Suppression Projects

Eastern Provinces

Newfoundland--The Department of Forest Resources and Lands treated a total of 26,336 ha in 1984: 23,226 ha were treated with aminocarb and the balance with Bt.

Nova Scotia--The Department of Lands and Forests treated 20,537 ha with Bt in 1984. The stands treated were mostly white and red spruce. Nova Scotia may expand its suppression program next year.

New Brunswick--Forest Protection Limited treated about 1.0 million ha. Bt was used on 37,300 ha; aminocarb and fenitrothion were used on the balance. Forest Patrol Limited treated an additional 215,000 ha.

Quebec--The Ministry of Energy and Resources reduced its program in 1984 to 709,106 ha, mainly in the Lower St. Lawrence and Gaspe areas. Bt was applied to 296,568 ha. Almost the same number of hectares was treated with aminocarb; a small percentage was treated with fenitrothion. Quebec has increased the use of Bt to about 40 percent of its program and plans to eventually rely entirely on this biological insecticide.

Ontario--The Ministry of Natural Resources treated 3,697 ha, including commercial forests, parks, plantations, and a moose yard, a dense stand of spruce and fir that provides shelter for the moose. Bt was used on 3,097 ha--84 percent of the treated area. The balance was treated with aminocarb and carbaryl.

Eastern United States

Vermont--Vermont's second cooperative State/Federal suppression project was conducted this year. Bt was again applied to protect small, privately owned, high-hazard spruce-fir woodlots. Approximately 70 ha were treated as part of the Spruce Budworm Demonstration Project started in 1983.

Maine--The Maine Forest Service treated 270,544 ha with three insecticides: mexacarbate, aminocarb, and Bt. Mexacarbate, which had been out of production, was last used in Maine in 1976. Mexacarbate and aminocarb were used on 181,059 ha; Bt was used on 89,485 ha.

This year, the Passamaquoddy Tribe in Maine treated approximately 9,660 ha. The Penobscot Indian Department of Natural Resources also conducted a suppression project on 1,377 ha. Both tribes chose to use Bt. In general, spruce budworm populations are on the decline.

International Paper Company treated an additional 43,000 ha; J.D. Irving Company, 70,000 ha.

Western Canada

No large-scale suppression projects were conducted in Western Canada, but some spots were treated with Bt.

Western United States

Southwestern Region--Two western spruce budworm projects were conducted in New Mexico in 1984.

One project was conducted on 96,400 ha by the Lincoln National Forest/Mescalero Apache Indian Reservation. They treated 77,200 ha with carbaryl and 19,200 ha with Bt. This project successfully protected foliage and reduced larval populations to an acceptable level.

The second project was conducted--for the third consecutive year--on portions of the west half of the Carson National Forest. Bt was used to treat 14,000 ha. The results were variable: most treatment areas sustained light to moderate defoliation because post-treatment budworm populations were high.

Pacific Northwest Region--In 1984, 324 ha were treated with Bt as part of a pilot project.

Outlook for 1985

Canada

In most of Canada, defoliation is expected to increase in 1985. Newfoundland is predicting an increase to 29,000 ha. While precise estimates are not available, both Prince Edward Island and Nova Scotia are also expecting increases. New Brunswick is expecting 3,570,000 ha of defoliation.

In Quebec, the overall picture is complicated by the fact that the population in western Quebec is collapsing because of heavy tree mortality. In eastern Quebec, there is also some decrease in population due in part to control operations. But in central Quebec, the budworm population is still very high. Overall, a slight decrease is predicted for 1985.

In Ontario, large population increases in northwestern Ontario could result in as much as 13,000,000 ha of defoliation in 1985.

The increase seen in the Prairie Provinces in 1984 is expected to continue.

In British Columbia, western spruce budworm is expected to cause severe defoliation on Douglas-fir in the Caribou area and moderate defoliation in Kamloops. Spruce budworms are also expected to cause light defoliation of fir and spruce stands in the Kitimat area. Spruce budworm predictions in British Columbia are difficult because of the complex of species involved. The spruce budworm and western spruce budworm are expected to increase in 1985; the 2-year budworm will decrease.

United States

After a 6-year decline, populations in the Lake States began increasing in 1983. As predicted, populations continue to rise, especially in Minnesota. On the Superior National Forest, the outbreak area tripled from one year to the next. In 1985, this increase is expected to continue both in intensity and acreage affected. Extremely high egg mass counts indicate the likelihood of topkill and mortality on the drier sites.

In Maine, only 1.4 million ha were in the high to extreme category. Populations have been declining for the past few years, and this decline is expected to continue. Results of the 1984 population survey show large decreases over much of the infested area. More than 50 percent of the infested area is predicted to have low larval populations. Much of northwestern Maine is predicted to have moderate populations and only spots of high to extreme populations. Only about 200,000 ha may be treated in 1985.

Spruce budworm populations on Passamaquoddy and Penobscot lands in Maine are also on the decline.

In New Hampshire, defoliation is at a new low--405 ha. The areas of light defoliation were not visible from the air, but low-level moth populations were detected with pheromone-baited traps. The area defoliated, the intensity of defoliation, egg-mass survey, and moth trapping all point to a continued decline.

Populations in Vermont have dropped to their lowest level since the outbreak began. No defoliation was detected with aerial surveys, although 72,000 ha were defoliated in 1983. The results of both larval counts and pheromone-baited traps were down 80 percent in the 1984 surveys. Tree mortality covers 18,797 ha; still, this is much less than in 1983 due to an accelerated salvage program. At the present rate of population decline, no treatment is anticipated in 1985.

In California, defoliation by a budworm steadily increased over the past 3 years from 2,000 ha in 1982 to 53,000 ha in 1984. Populations are expected to continue increasing so that over 57,000 ha may be defoliated in 1985.

Outbreaks are expected to continue in New Mexico, Arizona, Utah, Wyoming, Colorado, northern Idaho, eastern Montana, Oregon, and Washington. Tree mortality is expected to continue in New Mexico, Montana, Oregon, Utah, and Idaho. A suppression project is anticipated in New Mexico.

Tables

Table 1—Summary of 1984 spruce budworm defoliation, tree mortality, and suppression, Eastern Canada and United States

Province or State	1984		
	Area of defoliation	Area with dead and dying trees	Area treated
<u>1,000 hectares</u>			
Newfoundland	15	485	26
Nova Scotia	85	800	21
Prince Edward Island	15	30	0
New Brunswick	730	1,000 ¹	1,246
Quebec	11,200	NA ¹	709
Ontario	8,748	13,516	4
Alberta, Manitoba and Saskatchewan	170	0	0
Eastern Canada	20,963	15,831	2,006
Maine	2,228	122	395 ²
New Hampshire	< 1	12	0
Vermont	0	19	< 1
Michigan	78	32	0
Minnesota	147	41	0
Wisconsin	9	6	0
Eastern United States	2,463	232	396
Total	23,426	16,063	2,402

¹NA = not available.

²Includes projects carried out by the Maine Forest Service, the Passamaquoddy and Penobscot Tribes, International Paper Company, and J.D. Irving Company.

Table 2—Summary of 1984 budworm¹ defoliation, tree mortality, and suppression, Western Canada and United States

Province or Forest Service Region (States)	1984		
	Area of defoliation	Dead and dying trees	Area treated
<u>1,000 hectares</u>			
British Columbia	74	NA ²	0
Northern Region (MT, northern ID, northwestern WY)	900	145	0
Rocky Mountain Region (CO, WY)	888	NA	0
Southwestern Region (AZ, NM)	280	4	110
Intermountain Region (UT, NV, central ID, WY)	950	NA	0
Pacific Southwest Region (CA)	53	NA	0
Pacific Northwest Region (OR, WA)	1,385	1	< 1
Alaska Region	0	0	0
Total	4,530	150	111

¹ Table includes defoliation by Choristoneura fumiferana, C. retiniana, C. carana californica, C. orae, and C. biennis.

² NA = area of dead and dying trees not determined.

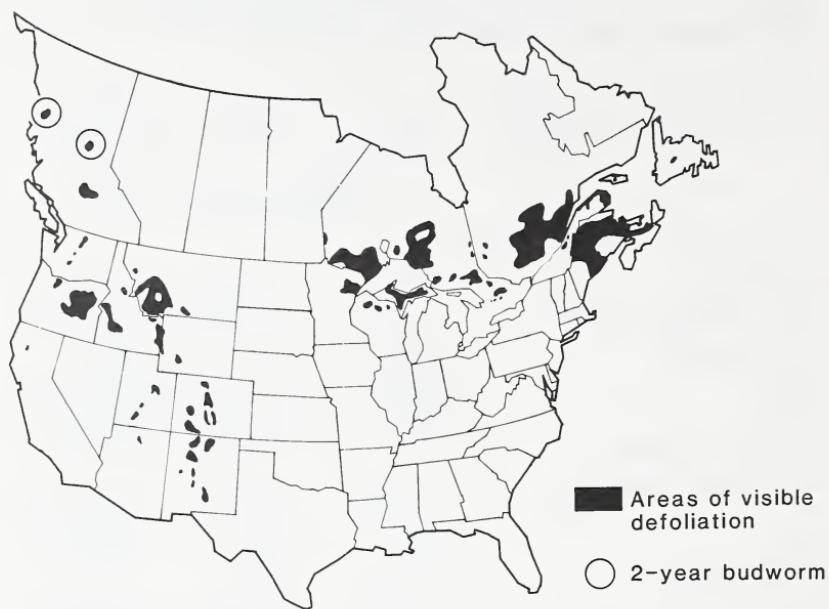
Table 3—Trend of defoliation caused by spruce budworms (*Choristoneura* spp.) in North America, 1984

Province, State, or Forest Service Region	1983	1984	Trend in 1984
<u>1,000 hectares</u>			
Newfoundland	67	15	52 - ¹
Nova Scotia	358	85	273 -
Prince Edward Island	26	15	11 -
New Brunswick	2,329	730	1,599 -
Quebec	12,266	11,200	1,066 -
Ontario	9,033	8,748	285 -
Alberta, Manitoba, and Saskatchewan	76	170	94 + ²
Maine	2,430	2,228	202 -
New Hampshire	2	< 1	1 -
Vermont	72	0	72 -
Michigan	60	78	18 +
Minnesota	51	147	96 +
Wisconsin	9	9	0
British Columbia	239	74	165 -
Northern Region	1,059	900	159 -
Rocky Mountain Region	1,100	888	212 -
Southwestern Region	140	280	149 +
Intermountain Region	1,127	950	177 -
Pacific Southwest Region	42	53	11 +
Pacific Northwest Region	1,047	1,385	191 +
Alaska Region	1	0	1
Total	31,534	27,956	3,716 -

¹- = decrease in defoliation.

²+ = increase in defoliation.

Map: 1984 Defoliation



Map: 1984 Treatment Areas



Note: The use of company names in this publications is for the readers information. Such use does not constitute an official endorsement by the U.S. Department of Agriculture or by the Government of Canada of any product or service by a company.

This publications reports the use of pesticides in both Canada and the United States. It does not contain recommendations for their use. All uses of pesticides must be registered by appropriate Canadian or U.S. agencies before they can be recommended for use in either country.

CAUTION: Pesticides can be injurious to human beings, domestic animals, desirable plants, fish or other wildlife--if they are not handled or applied properly. Use all pesticides selectively and carefully. Follow recommended practices for the disposal of surplus pesticides and pesticide containers.



